TROOPERS

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UI Redressing Attacks on Android Devices

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ABOUT ME

- Horst Görtz Institute for IT-Security
- German Book
  - Clickjacking und UI-Redressing
- WebAppSec: Trainings, Pentests
- Speaker at Blue Hat, Black Hat, German OWASP Day, PHDays, ...
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NOTE

- This talk is based on the paper
  - UI Redressing Attacks on Android Devices

    http://is.gd/g60ZUx
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1. Introduction
2. Related work
3. Porting UI redressing to Android devices
4. New browserless attacks
5. Mitigation techniques
6. Conclusion and outlook

1. Introduction

INTRODUCTION

- UI redressing is a known problem since 2002
- Security problem has been overlooked until 2008 → Clickjacking
- Clickjacking $\subset$ UI redressing
  - The subclass consists of attacks like cursorjacking, filejacking, tabnabbing, and inter alia tapjacking
  - In essence, all of these attacks need a Web browser to be executed

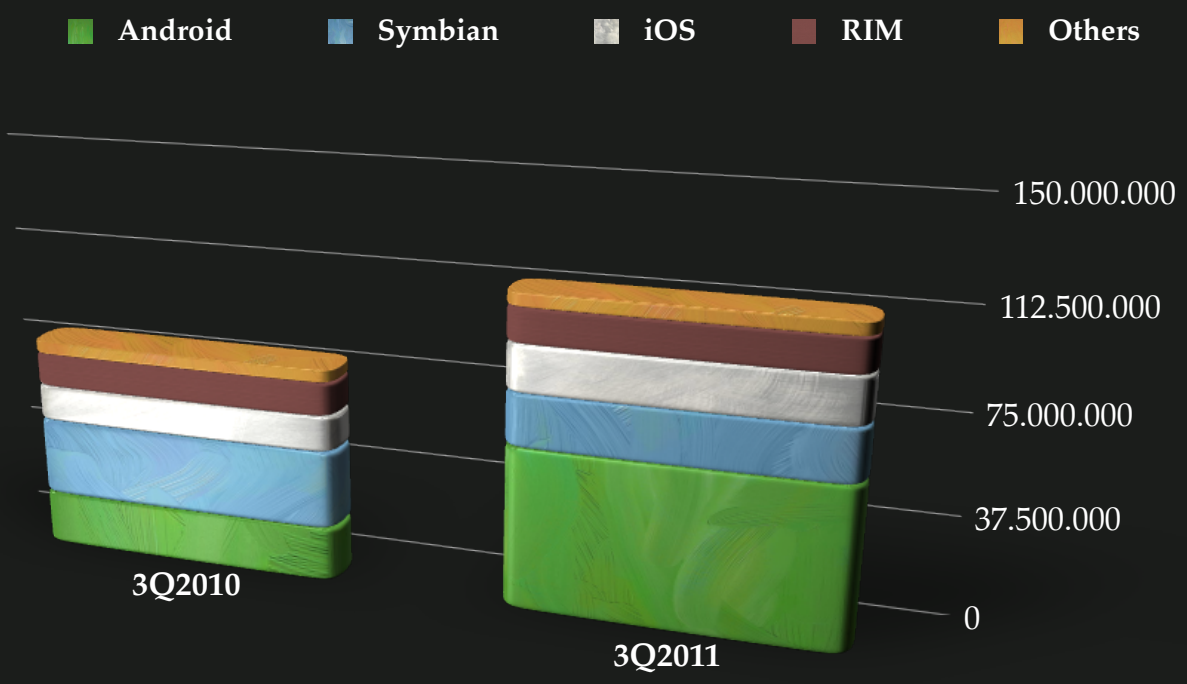
Introduction

- Considering the given attack vectors on desktop-based Web browsers, we pose the following question:

Can UI redressing attacks be ported to smartphone-based systems?

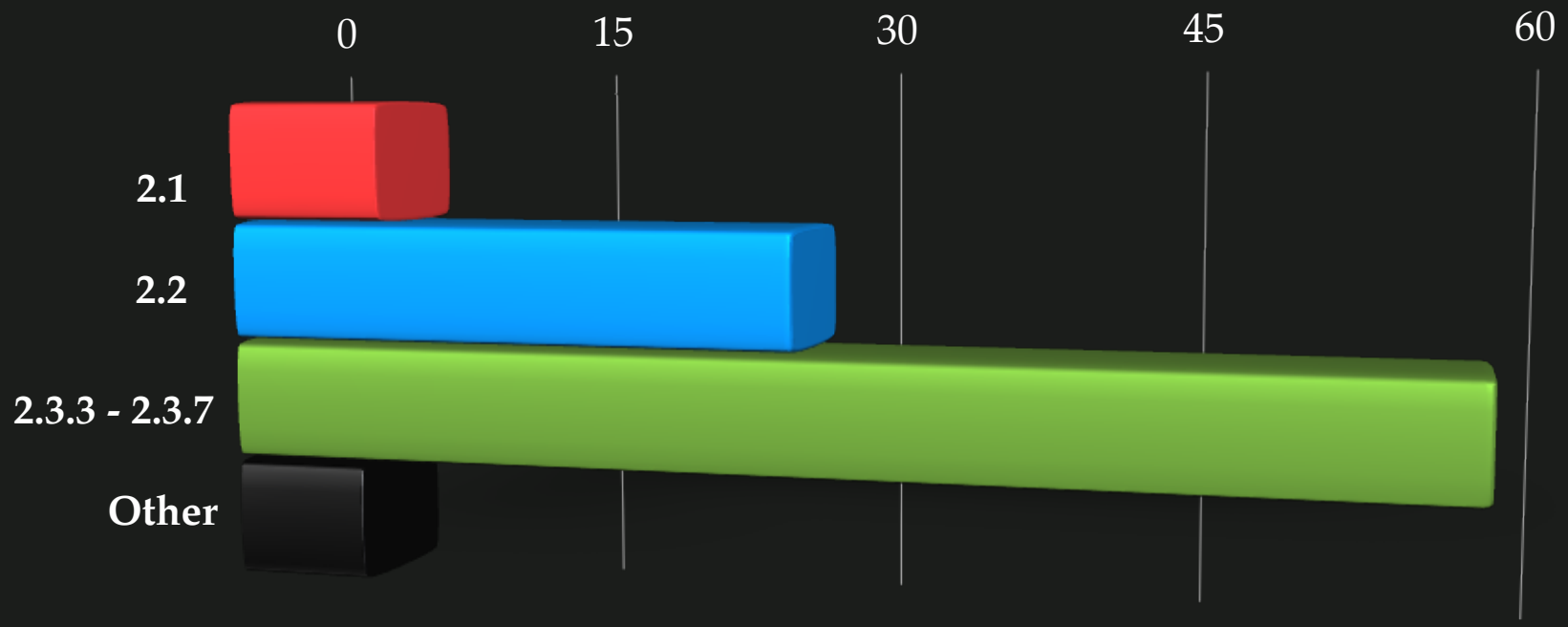
INTRODUCTION

- We focus on the Android operating system
  - Source: Gartner (November 2011)
  - Situation in November 2012: Android 72.4%, iOS 13.9%

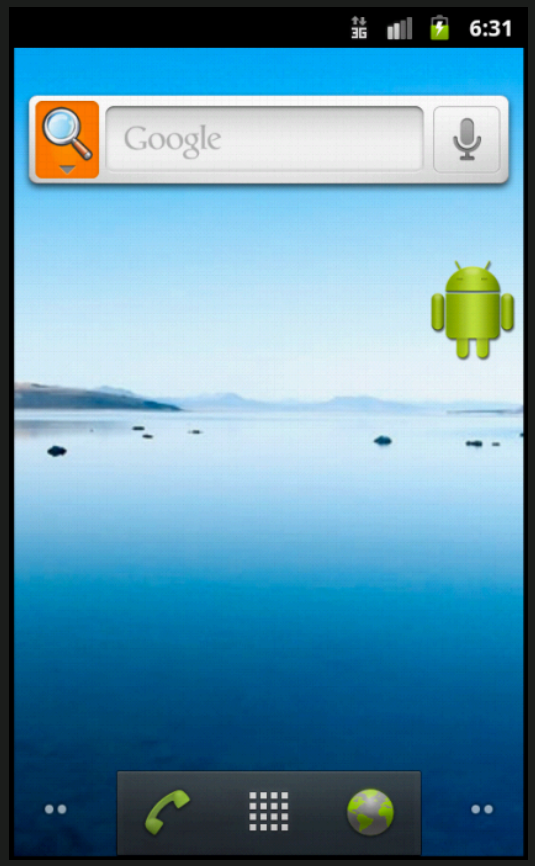


INTRODUCTION

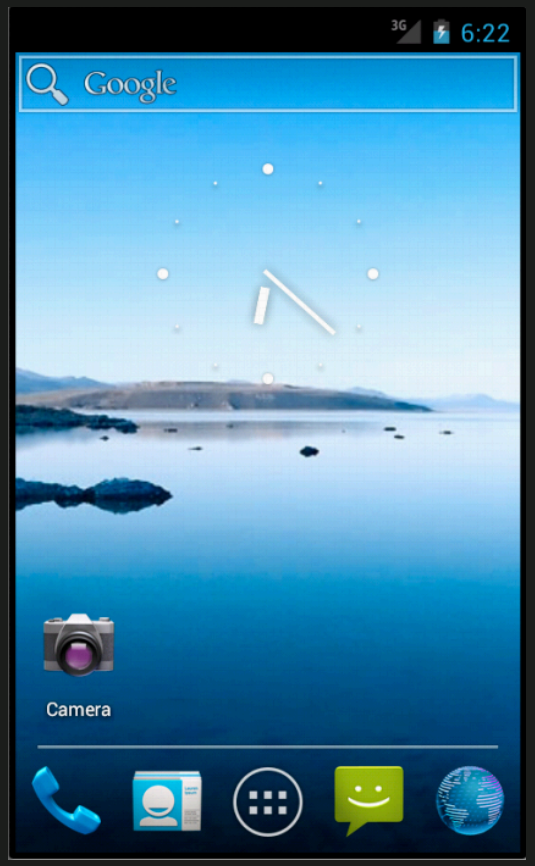
- We focus on the Android operating system
  - Source: Android.com; 14-day period data- February 1, 2012



INTRODUCTION



ANDROID 2.3.3



ANDROID 4.0

INTRODUCTION

- This talk focuses on two points

1. Attacks and countermeasures for desktop-based Web browsers available for Android
2. A tapjacking attack technique which does not need a Web browser to execute

2. Related work

RELATED WORK

2.1. Desktop-based UI Redressing Techniques

2.2. Browserless UI Redressing Attacks

2.1. Desktop-based UI Redressing Techniques

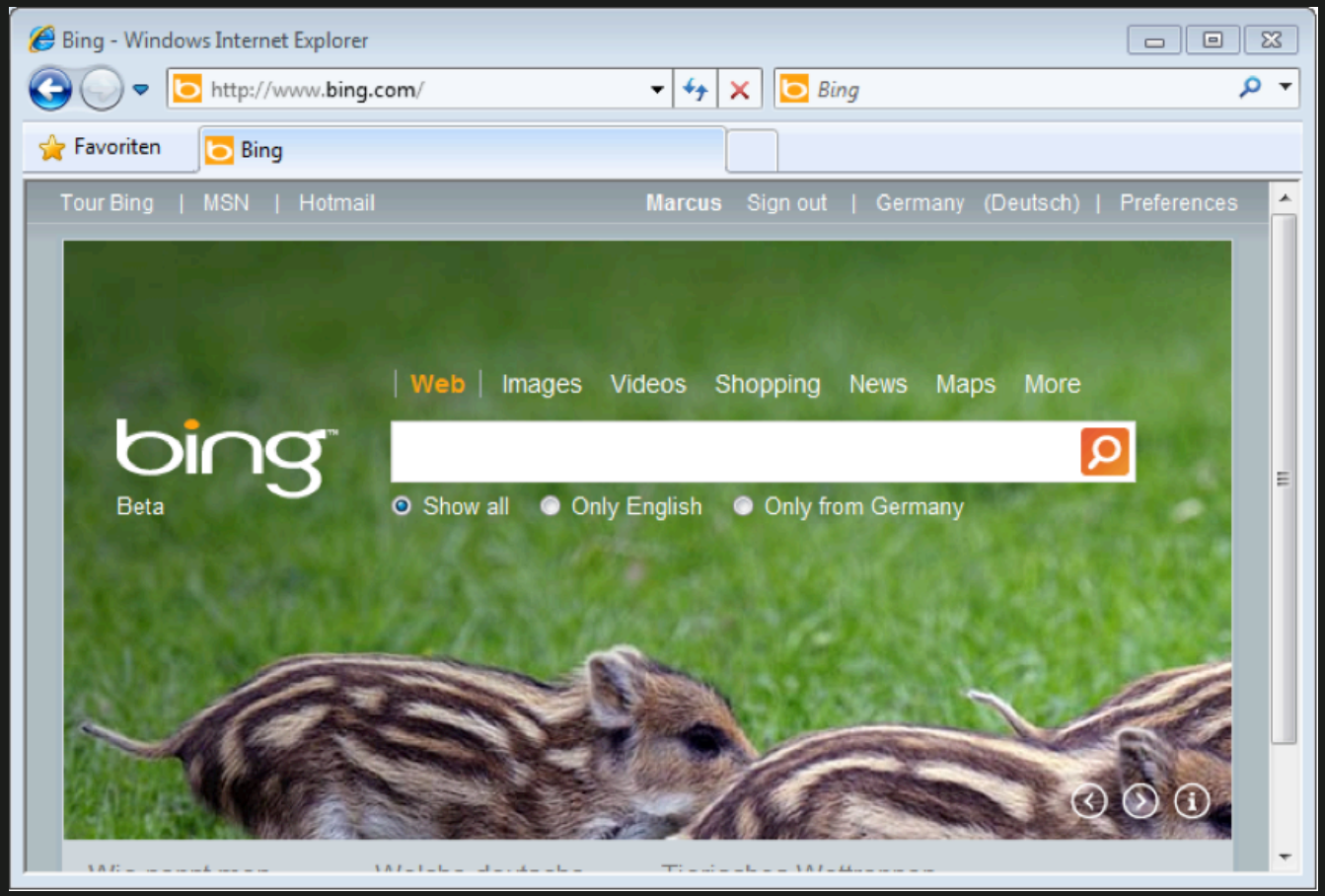
RELATED WORK – UI REDRESSING

- Clickjacking
- Strokejacking
- Drag-and-drop operations
- Content extraction
- Event-recycling
- SVG masking

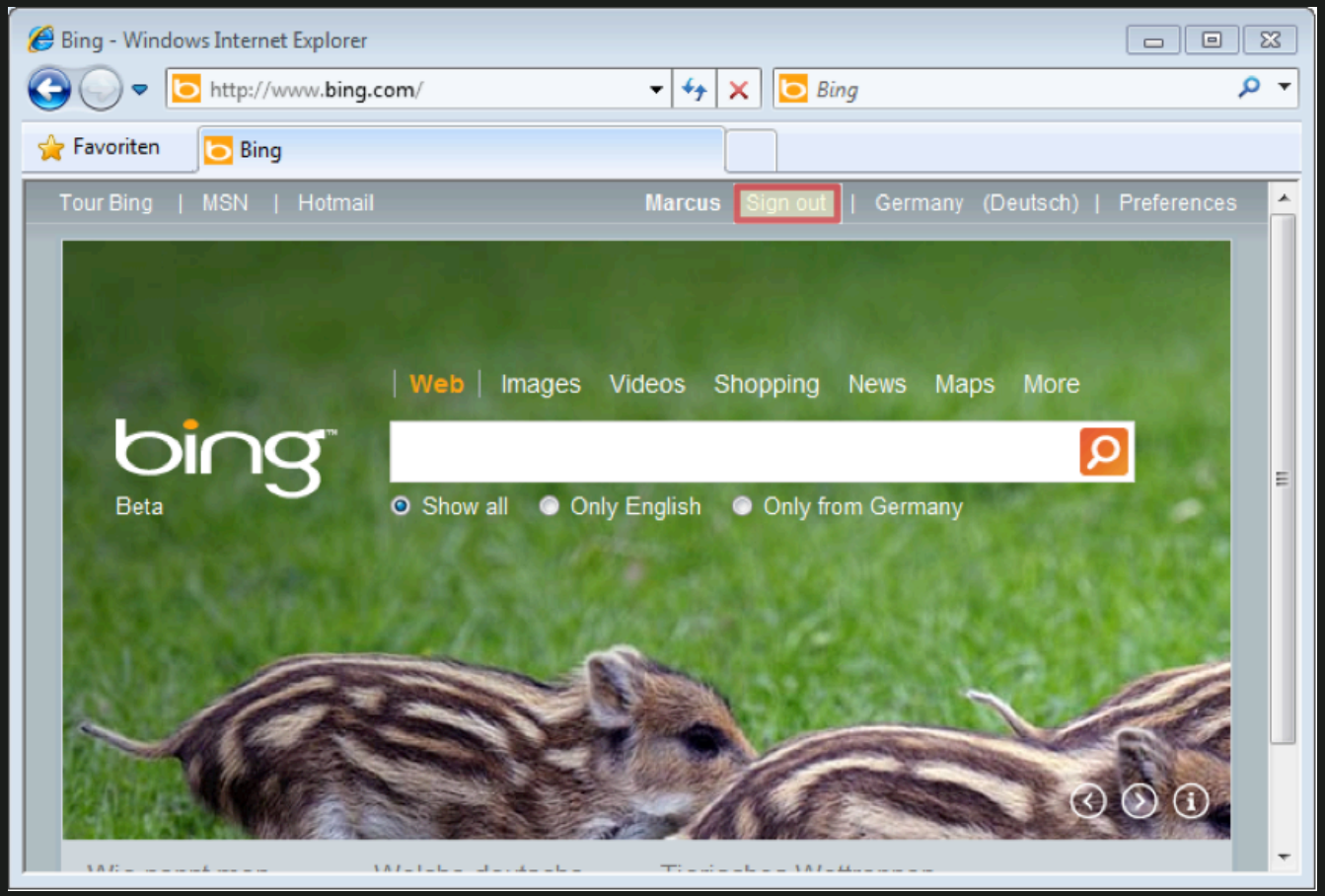
RELATED WORK – CLICKJACKING

- Classic clickjacking
- Likejacking and sharejacking
- Nested clickjacking, double clickjacking
- Cookiejacking, filejacking
- Eventjacking, classjacking
- Cursorjacking, tabnabbing
- Combinations with CSRF, XSS, and CSS

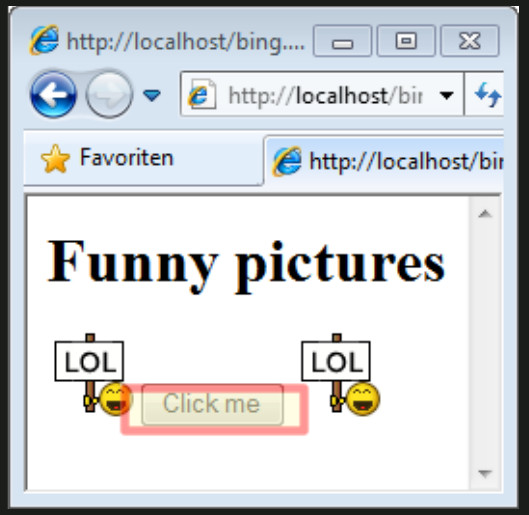
RELATED WORK – CLICKJACKING



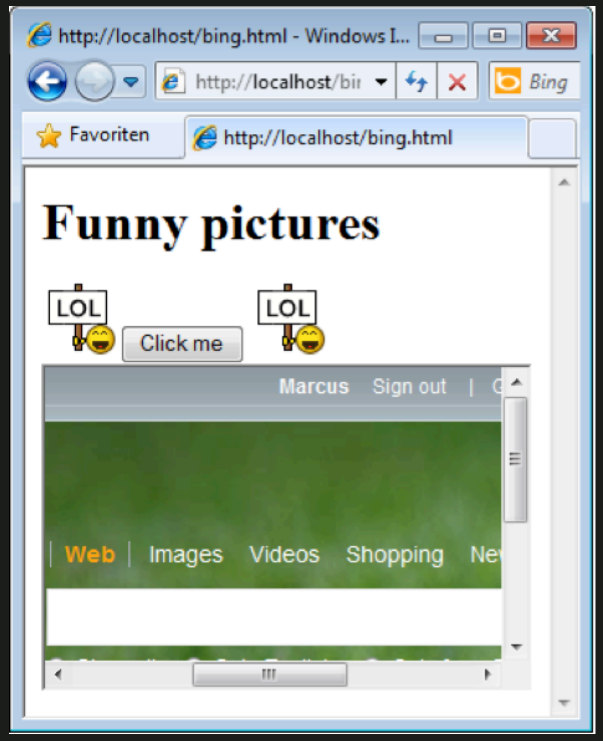
RELATED WORK – CLICKJACKING

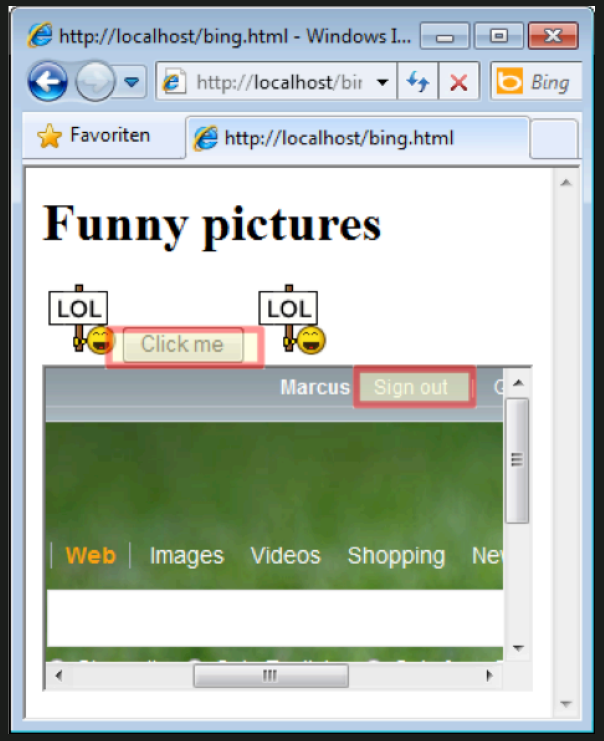


RELATED WORK – CLICKJACKING

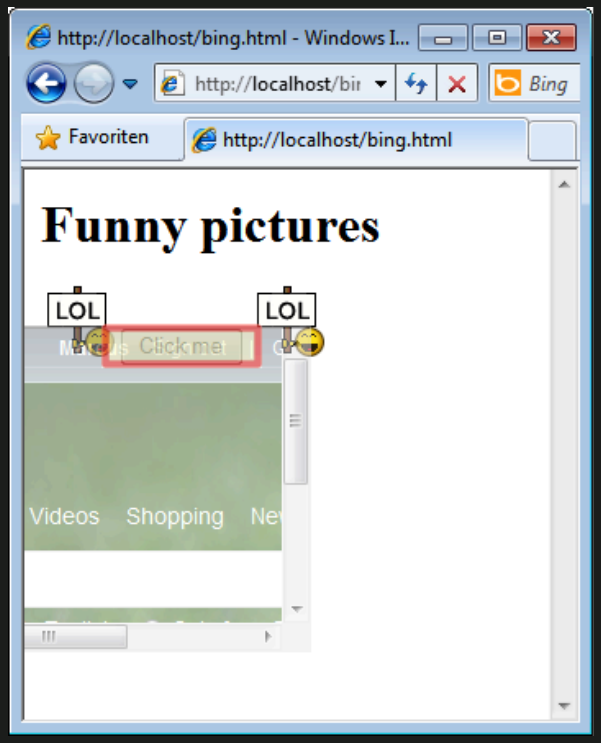


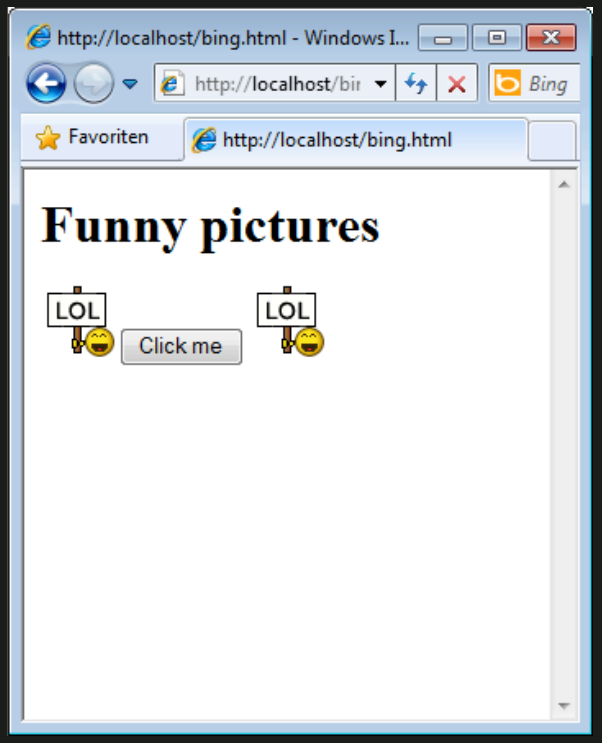
RELATED WORK – CLICKJACKING





RELATED WORK – CLICKJACKING





RELATED WORK – CLICKJACKING

```
<h1>Funny pictures</h1>
<img src="lol.gif">
<button>Click me</button>
<img src="lol.gif">
<iframe style="position:absolute; z-index:1;
      opacity:0.0; filter:alpha(opacity=0);
      left:-120px; top:95px;"
      width="300" height="200"
      src="http://www.bing.com">
</iframe>
```

2.2. Browserless UI Redressing Attacks

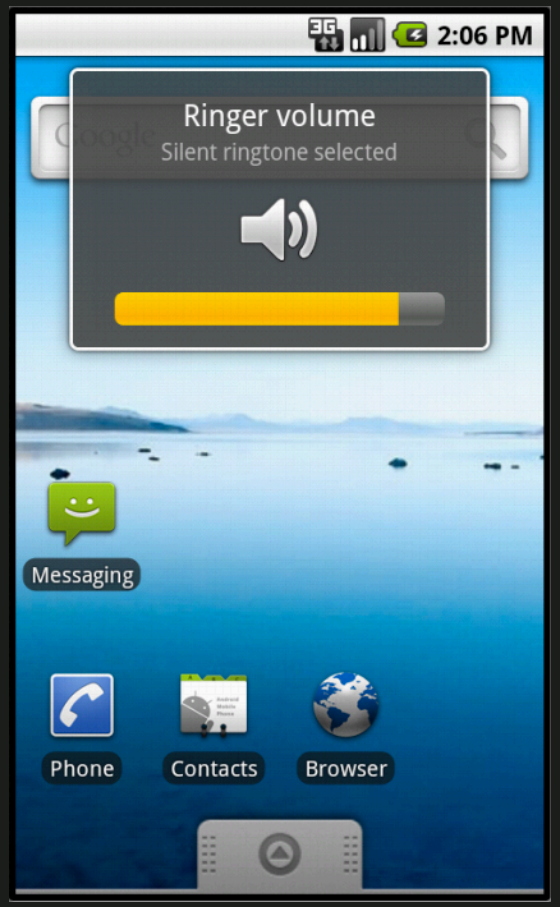
RELATED WORK

- Is it possible to perform browser-like UI redressing attacks on mobile devices without using a Web browser or, at the very least, without using it directly?

RELATED WORK

- David Richardson in 2010 about the Android trust model
  - An application is allowed to programmatically open a dialog but not to interact with it
- Idea
  - Use a `toast`-view to show a quick little message to the user
    - Basic idea: Be as unobtrusive as possible

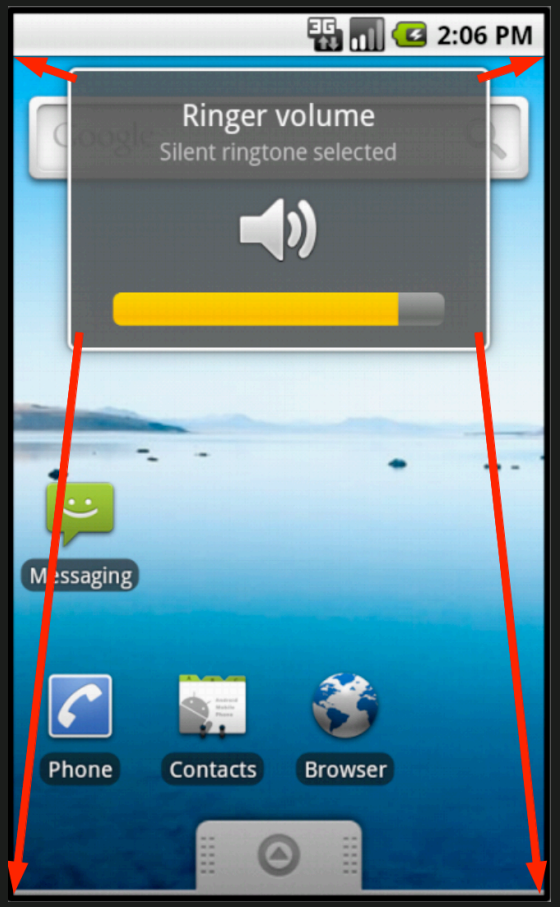
RELATED WORK



RELATED WORK

- Jack Mannino published a proof of concept of a tapjacking attack in 2011
  - Scaling the usually small notification message to the entire display of the mobile device
  - Subsequent usage of the default constant `LENGTH_LONG`

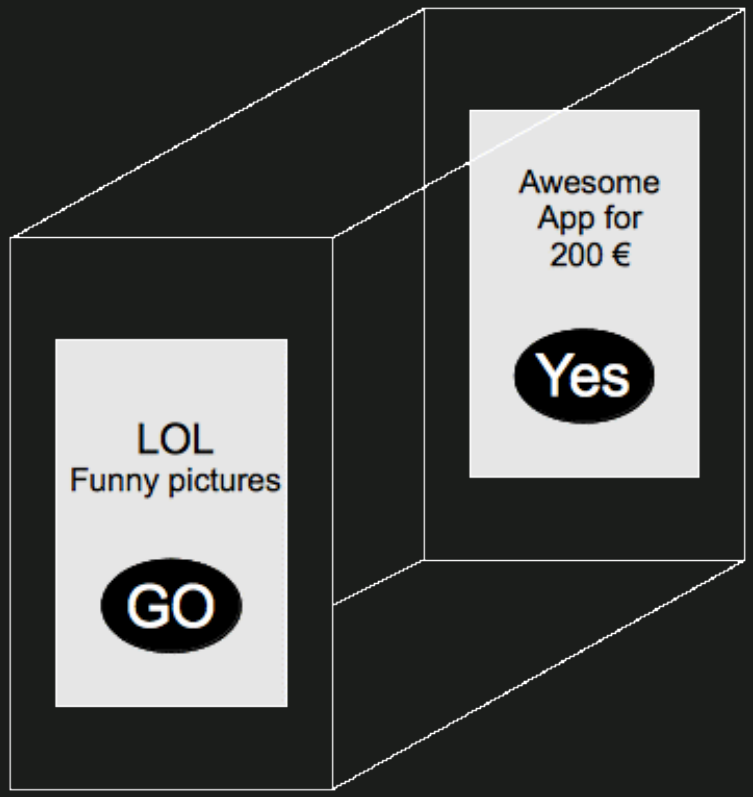
Related work



RELATED WORK

- Crucial point
  - A touch gesture on such a message or notification will be passed through to the underlying application
  - Similar to Clickjacking
- Idea
  - Create a notification message, which looks like a normal application

RELATED WORK



3. Porting UI redressing to Android devices

PORTING UI REDRESSING

- Classic clickjacking, classjacking, strokejacking
  - Requires a Web browser supporting frames, CSS, JavaScript, and HTML5
- Nested clickjacking, filejacking, tabnabbing, content extraction, event-recycling, and SVG masking
  - Additional features in desktop-based Web browsers

PORTING UI REDRESSING

- Nowadays, any Web browser one requires can be downloaded via Google Play
- Not transferable attacks
  - Cursorjacking
  - Cookiejacking
  - Double clickjacking and pop-up-blocker bypasses

4. New browserless attacks

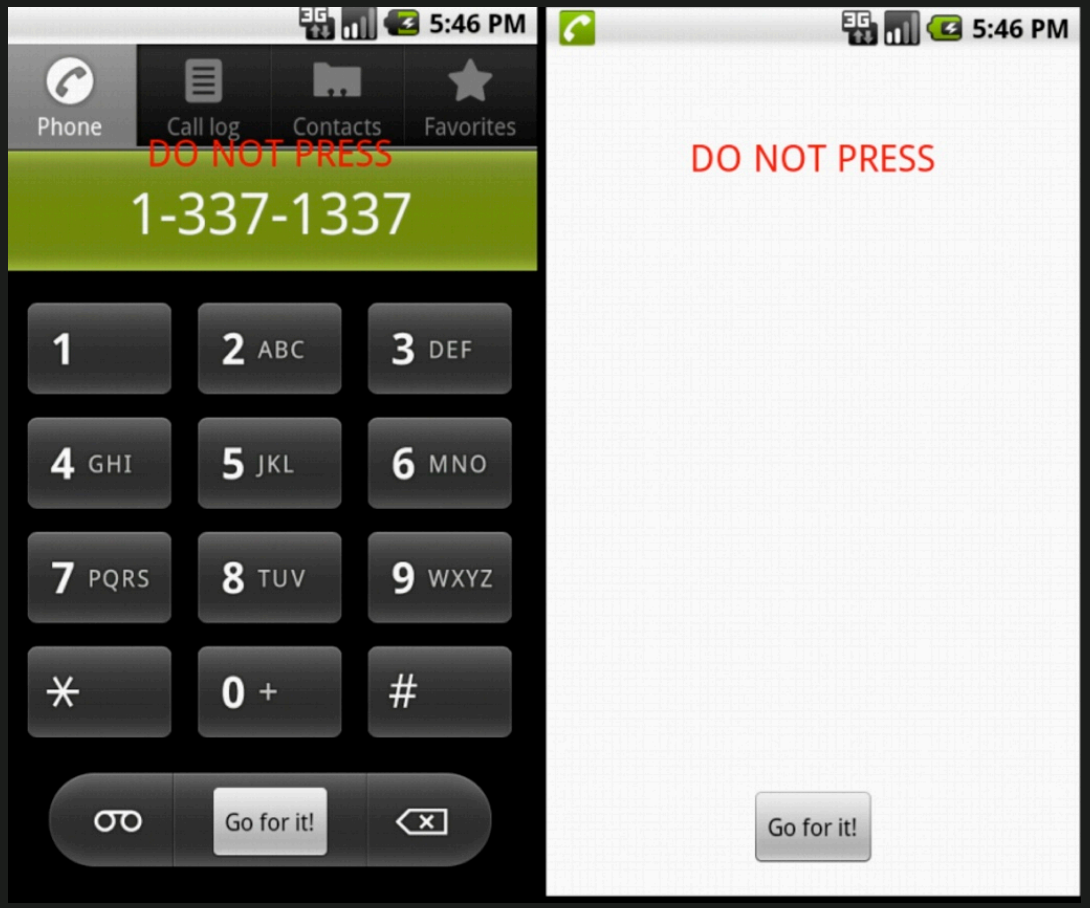
NEW BROWSERLESS ATTACKS

- In addition to the attack described by Jack Mannino we can do
  - Contact data manipulation
  - Native browser utilization
  - Touch gestures logging
  - Predefined phone calls
  - Installing applications in the background

NEW BROWSERLESS ATTACKS

- All of these attacks are using the same technique
  1. There is a visible attacker's application in form of a notification in the foreground
  2. There is a target application in the background

NEW BROWSERLESS ATTACKS



NEW BROWSERLESS ATTACKS

- There is a limited number of operations like opening the phone call application
- Solution: Unauthorized home screen navigation attack
  - Substantially extend the limited set of attacks
  - An attacker needs more touch gestures of a victim

5. Mitigation techniques

MITIGATION TECHNIQUES

5.1. Browser-Based UI Redressing

5.2. Tapjacking Defense Mechanisms

5.1. Browser-Based UI Redressing

MITIGATION TECHNIQUES

- Frame Buster
  - Consists of a conditional statement and a counter-action

```
if (top.location != location)
   top.location = self.location;
```

  - Busting frame busting is possible
- August Detlefsen et al. published the most attack-resistant countermeasure against busting frame busting techniques

MITIGATION TECHNIQUES

```
<style id="antiClickjack">
  body{display:none !important;}
</style>
<script type="text/javascript">
  if (self === top) {
    var antiClickjack = document.
      getElementById("antiClickjack");
    antiClickjack.parentNode.
      removeChild(antiClickjack);
  } else {
    top.location = self.location;
  }
</script>
```

MITIGATION TECHNIQUES

- X-Frame-Options
  - HTTP header developed by Microsoft in 2008
  - Checks if a website should be loaded in a frame or not
    - `DENY`
    - `SAMEORIGIN`
    - `ALLOW-FROM origin`
  - Restricted to modern browsers such as Firefox ≥3.6.9, Opera ≥10.5, and IE ≥8.

MITIGATION TECHNIQUES

- Content Security Policy
  - Old CSP: Aside from the framing protection, one can also identify other targets, such as preventing data injection attacks or cross-site scripting (*frame-ancestors*)
  - New CSP: Focus on sandboxing and source specification of style sheets, script files and similar issues

MITIGATION TECHNIQUES

Browser	Engine	XFO	oCSP	nCSP
Android – 4.0.3	WebKit	✓	✗	✗
Dolphin – 8.7.0	WebKit	✓	✗	✗
Firefox – 4.0.3	Gecko	✓	✓	✗
Opera Mini – 7.0	Presto	✓	✗	✗
Opera Mobile – 12.00	Presto	✓	✗	✗

MITIGATION TECHNIQUES

Alexa	X-CSP	X-WebKit-CSP
TOP-100,000	3	1
TOP-500,000	9	1
TOP-1,000,000	18	1

5.2. Tapjacking Defense Mechanisms

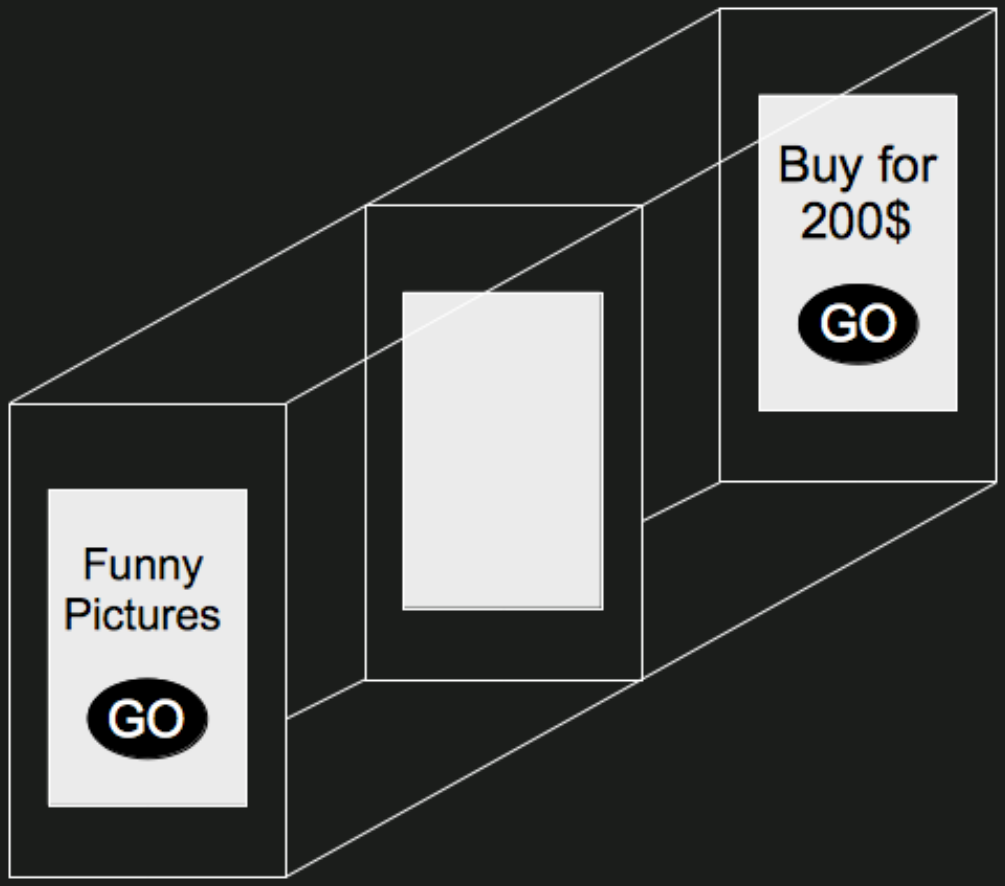
MITIGATION TECHNIQUES

- Android touch filter
  - Blocks touch gestures received whenever view's window is obscured
  - `setFilterTouchesWhenObscured()`
    or, alternatively, with the attribute
    `android:filterTouchesWhenObscured`
  - Not enabled by default and they are only available in Android versions higher than 2.2

MITIGATION TECHNIQUES

- Tapjacking Security Layer (TSL)
  - Should be implemented by the Android team into the kernel in the near future
  - It opens automatically once a user fires an application
  - It is always in the background and remains opened until the application in its forefront gets closed
  - A touch gesture on the TSL will be blocked

MITIGATION TECHNIQUES



6. Conclusion and outlook

CONCLUSION AND OUTLOOK

- Most of the existing UI redressing attacks can be used with very little effort
- There are a lot of countermeasures: Frame Buster, XFO, and the CSP
- We have introduced a browserless UI redressing attack and a new security layer against tapjacking attacks

CONCLUSION AND OUTLOOK

- We must recommend that vendors of security software urgently implement our TLS
- HTML5 and CSS3 drafts are partially implemented in Web browsers
  - The field of attacks will continuously expand
  - Long-lasting 'cat and mouse game‘

Thank you for your attention.

Any questions?